FURTHER PAPERS

RELATING TO THE

CONSTRUCTION OF RAILWAYS.

(NORTH ISLAND.)

VIII.—REPORTS AND ESTIMATES ACCOMPANYING PARLIAMENTARY SURVEYS.

I.—Wellington to Napier.

II.—Auckland to Newmarket.

PRESENTED TO BOTH HOUSES OF THE GENERAL ASSEMBLY, BY COMMAND OF HIS EXCELLENCY.

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FURTHER PAPERS RELATING TO CONSTRUCTION OF RAILWAYS.

WELLINGTON TO NAPIER RAILWAY.—WELLINGTON TO MASTERTON.

No. 1.

Mr. ROCHFORT to the Hon. W. GISBORNE.

SIR,— Wellington, 12th August, 1871.

I have the honor to send herewith plans, sections, report, and estimate of that portion of the Wellington and Napier Line of Railway between Wellington and Masterton. As might be expected, the cost of this line, with a mountain 1,330 feet high above the sea level to surmount, and four large rivers to bridge, somewhat exceeds the ordinary average of New Zealand railways. I estimate a line of 3 ft. 6 in. gauge, with stations and sidings, can be made and equipped for about £4,857 per mile.

From Wellington to Petoni the line will skirt the road on the seaside; and, on inspecting the plans, you will see that the curves are so fitted to the road that a minimum amount of embankment is attained. This can be made cheaply, by throwing down the rock cliffs in mass, which then will have to be carried only a short distance; at the same time the road will be widened.

From Petoni to the crossing-place of the Hutt River near Silver Stream, the line is forced near the river, and causes rather heavy cutting. The place known as the Gorge is passed on this side without any difficulty. The crossing of the Hutt River is good. The bridge starts from the hill itself, and crosses the part of the river liable to floating timber with seven 66 feet spans; the part beyond, being shallow-flooded ground, is crossed with 538 feet of low bridging of a cheaper character, having spans only 16½ feet. Beyond this again, in a low place, 132 feet of low bridging is allowed to act as a safeguard to the embankment in the event of unusually heavy floods. From the Silver Stream the line follows along one side of the trunk road until reaching a point where the hill abuts on the road, about one mile nearer town than Cruickshank's saw-mill. All along this portion, ballast can be procured at a low cost. The line now contours up the hill which divides the Hutt from the Mungaroa Valley, reaching the latter by a cutting through the crown of the hill behind Mr. Cruickshank's. This portion is full of curves, the sharpest being 200 feet radius. A gradient of 1 in 43, about a mile and a half long, brings us to the top, when the line runs over level forest for two miles straight. The soil is very stony, and will itself supply sufficient ballast when the ditches are thrown up. To the top of the Mungaroa Hill, which is crossed about 100 feet below the level of the present road, the curves are numerous, and the grades vary from 1 in 40 to 1 in 41. The line now runs level for four miles, as far as the Pakuratahi. The hill slopes are light, and average about an angle of 20° with the horizon.

We now commence the ascent in earnest—two miles of 1 in 49, and three of varying grades from 1 in 40 to 1 in 46, bring us to the main saddle, and here we get a rest of 15 chains of level. The saddle is 1,379 feet above the sea level, and 1,232 feet above Featherston by spirit level, which agrees very closely with height ascertained by aneroid observation on my preliminary survey, the difference being only a few feet. This shows how these instruments may be relied on in preparatory surveys. The side slopes average about 30° with the horizon; there is not much rock out-cropping, but we may expect to find it a few feet below the surface whenever the inclination of the hills is over 35°. I have based my calculations on this assumption, and have reckoned on turning the rock to account in building up retaining walls to lessen the contents of the embankments. On the Wairarapa side of the range, the hill slopes are steeper, and several long viaducts over deep gullies will have to be made, otherwise the character of the line is similar—grades, nine miles, 1 in 41, and one mile and a half, 1 in 54, to the plains of the Wairarapa. There the country is easy, the only expensive works being the bridges. The line passes through Featherston along the side of Johnston Street, passing the large Government reserve on which the old Land Office stands. This reserve would be useful for station purposes. The crossing of the Tauherinikau was chosen directly behind Mr. Bunny's house, that being the most favourable spot outside the Gorges. The actual bridge has only three 66-feet spans, but low bridging of 330 feet is allowed to carry off flood waters. Ballast is plentiful all through the valley; the plain intervening between the last river and the Waiohine is nearly all covered with stones. The Waiohine is crossed between Cotter's and Revans' saw-mills, with a bridge having twelve 60-feet spans and one 52, besides 198 feet of low bridging, which is distributed over the flooded ground. This crossing was chosen partly because it was the narrowest between Greytown and the Gorge, and partly to avoid a large swamp which lies between the railway line and the road. The line now crosses the Matai-Rawa Plain, which is also very stony, and then goes through the bush known as "Three-Mile Bush." This bush is really about five miles through, and free from swamps along the line, and uniformly level; several clearings are passed through by the railway. Totara can be got in quantity in several places in this bush. On emerging on the Taratahi Plain, a swamp 18 chains over has to be crossed; then another stony plain to the Waingawa River, which is crossed one mile and a half west of the coach road with thirteen 66-feet spans and two short pieces of low bridging of 99 feet and 66 feet for flood opening. This crossing was chosen because it is the narrowest, and as offering a good site for a bridge, also as being the shortest line to the Gorge. The line will pass about two and a half miles to the west of Masterton, but the intervening country is open and level.

I will now compare the line of railway just described—as to length, cost, &c.—with one in which the Rimutaka Range would be pierced with a tunnel, with the view of shortening the distance.

At an early stage of my survey, I was called upon to report on the probable cost and length of a tunnel line, and accordingly did so, but with information at that time necessarily imperfect. Part of this I am now able to supply correctly, and the rest may be gathered, although not in full, from a published Report on a Tunnel Line by C. O'Neill, Esq.

I will take, as common to both lines, two points—the first where the two lines would cross each other about one mile and a half south of the Pakuratahi Hotel, which by the railway line is twenty-seven miles forty-eight chains from Wellington; the second at the Telegraph Station at Featherston, which is just a quarter of a mile beyond Abbott's Hotel. The distance between these two points by the line *over* the Rimutaka being exactly twenty-one miles fifty-three chains; by the Tunnel Line the distance will be thirteen and a quarter miles, made up as follows, viz., nine and a half miles by the main creeks between Pakuratahi Hotel and Abbott's Hotel, Featherston (see Mr. O'Neill's report), to which must be added the one mile and a half and quarter-mile just described, to the points common to both, as well as at least two miles for contouring the lateral valleys and points of hills between the ends of the tunnel and the points in question. This allowance, it will be seen, is not too much, as the length of the coach road exceeds the length of the line by the creeks by more than two miles, at a much steeper gradient than the railway just surveyed.

The comparative cost of the two lines may therefore be shown as follows. I have already stated that the average cost per mile for the whole length of line is £4,850 per mile; but, to make the comparison fair, the estimated cost of that portion of the line now under consideration should alone be considered, and that amounts, without allowing for rolling stock, to £6,322 per mile. We have, therefore, assuming Mr. O'Neill's estimate for the tunnel to be correct—tunnel line 13¼ miles—viz.:

Tunnel, 1⅛ mile, at £660 per chain	£85,800
11⅛ miles of railway, at £6,322	73,496
	£159,296
Rimutaka Line—21 miles 53 chains of railway, at £6,322 ...	136,954
Showing a saving in cost by the Rimutaka Line of	£22,342

And a saving in distance by the Tunnel Line of 8 miles 33 chains.

I need not explain that the time expended in making the Tunnel Line would be much longer than needed for the other—probably three times as much, or in the proportion of five or six years to two years.

I have not yet completed the second section of the line, viz., from Masterton to the Manawatu Gorge, but hope to be able to furnish plans, report, &c., in about a month. The first section terminates about a quarter of a mile on this side the Waipoua, a distance of 70 miles 5 chains from Wellington.

I have, &c.,
JOHN ROCHFORT.

Enclosure in No. 1.

APPROXIMATE ESTIMATE—Wellington and Napier Railway.

From Wellington to Masterton—length, 70 miles 5 chains; single line of railway, 3 feet 6 inch gauge; with 40 lb. rails.

	£	s.	d.
Bush Clearing—33 miles 16 chains, 2 chains wide, at 10s. per chain	1,328	0	0
Earthwork—			
Main Line, 828,857 cub. yards, at 1s. per cub. yard	41,442	0	0
Mixed earth and loose rock, 199,323 cub. yards, at 1s. 6d. per cub. yard ...	14,949	4	6
Rock cutting, 107,144 cub. yards, at 4s. 6d. per cub. yard	24,107	8	0
Stations, Sidings and Deviations, and Approaches, 61,248 cub. yards, at 1s. per cub. yard	3,062	8	0
Retaining Walls, 45,680 cub. yards, at 12s. per cub. yard	27,408	0	0
Bridges and Viaducts—2,826 feet, at £4 per foot	11,304	0	0
„ 259 feet, at £5 per foot	1,295	0	0
„ 3,900 feet, at £6 per foot	23,400	0	0
„ 2,688 feet, at £10 per foot	26,880	0	0
Culverts—one hundred and fifty-nine, 1 foot, at £6 10s. each	1,033	10	0
„ sixteen, 1 foot 6 inches, at £13 each	208	0	0
„ fifty-eight, 2 feet, at £16 each	928	0	0
„ nine, 3 feet, at £32 each	228	0	0
„ eighteen, 4 feet, at £36 each	648	0	0
„ nine, 6 feet, at £48 each	432	0	0
Permanent Way—			
Rails and Fittings, 69 tons, at £10 10s. per ton ... £721 10 0			
Sleepers, 2,050, at 3s. each 307 10 0			
Ballast, at 2s. per yard 176 0 0			
Laying 88 0 0			
70 miles 5 chains, at ... £1,293 0 0 per mile	90,526	3	3
Stations and Sidings, say 3 miles at £1,293 per mile	3,879	0	0
Level Crossings, say	500	0	0
Turntables, four, at £110 each	440	0	0
Points, Switches, and Crossings, twenty sets, at £15 each	300	0	0
Goods Cranes (1½ ton), six at £30	180	0	0
Signals, eight, at £25	200	0	0
Station Platforms and Sheds, say six, at £250 each	1,500	0	0
Water Tanks, say	200	0	0
Fencing, 77 miles 20 chains, at 20s.	6,180	0	0

	£	s.	d.
Rolling Stock—			
Locomotives, four, at £1,600	6,400	0	0
Passenger Carriages, six, at £300	1,800	0	0
Goods Waggons, forty, at £80	3,200	0	0
Covered ditto, six, at £105	630	0	0
Mineral ditto, six, at £80	480	0	0
Break Vans, four, at £230	920	0	0
Engineering expenses, 5 per cent.	14,779	13	6
Contingencies, 10 per cent.	29,559	7	0
Total	£340,327	14	3

JOHN ROCHFORT.

WAIKATO RAILWAY—ALTERNATIVE LINES AUCKLAND WHARF TO NEWMARKET.

No. 2.

Mr. WRIGG to Mr. BLACKETT.

SIR,— Auckland, 15th August, 1871.

I have the honor to transmit tracings of the plan and sections of the three alternate lines as surveyed from Newmarket to Auckland, with an approximate and relative cost of each. I have attached to the estimates such notes as appeared to me desirable for your information, and have only to add that the quantities have been taken out at the slopes noted on the section, and as if the ground in cross section was level.

I am of opinion that the two small tunnels on the Coast Line will be safe with timber lining, and that they could be executed at the price per yard I have named, the material being beds of sandstone and indurated sand in horizontal layers, so that it is not probable that water will interfere with their construction.

I have, &c.,
HENRY WRIGG.

John Blackett, Esq., Acting Engineer-in-Chief,
Wellington.

Enclosure in No. 2.

WAIKATO RAILWAY.—Approximate and Comparative Estimate of the three alternate Lines from Newmarket to Auckland, exclusive of Stations and Sea Embankments Protection.

Domain Line—length, 2 miles 3 furlongs 1 chain.	£	s.	d.
Excavations, 51,760 cubic yards, at 1s. 4d.	3,450	13	4
„ 16,830 cubic yards, at 2s. 6d.	2,103	15	0
Accommodation Bridge, about	150	0	0
Foot Bridge at Constitution Hill, about	300	0	0
Timber Viaduct, about	3,280	0	0
Accommodation Bridges in Domain, say	800	0	0
Bridge at Parnell Road, about	330	0	0
Fencing and Draining, 151 chains, at £3	453	0	0
Culverts, and repairs of existing ones	180	0	0
Permanent Way, 4,202 yards, at 16s....	3,361	12	0
Total	14,409	0	4

Tunnel Line—length, 2 miles 1 chain.	£	s.	d.
Excavations, 10,529 cubic yards, at 1s. 4d.	701	18	8
„ 16,830 cubic yards, at 2s 6d.	2,103	15	0
Accommodation Bridge, about	150	0	0
Culvert at Mechanics Bay, about	400	0	0
Repairs to present Culvert (large)	150	0	0
Repairs to present Viaduct, say	100	0	0
491 yards of Tunnel to complete, at £30	14,730	0	0
Fencing and Draining, 55 chains at £3	165	0	0
Permanent Way, 3,542 yards, at 16s....	2,833	12	0
Small Culverts, and repairs of same	60	0	0
Total	£21,394	5	8

Coast Line—Length, 3 miles 3 furlongs 1 chain.

	£	s.	d.
Excavations, 125,539 cubic yards, at 1s. 4d.	8,369	5	4
„ 34,698 cubic yards, at 2s. 6d.	4,337	5	0
Accommodation Bridge	150	0	0
Culvert in Mechanics Bay for Saw Mill	150	0	0
Smaller Culverts and repairs of existing one	210	0	0
Two Road Bridges, about	600	0	0
Two small Tunnels, lined with timber, 313½ yards, at £7	2,194	10	0
Fencing and draining, 243 chains, at £3	729	0	0
5,962 yards of Permanent Way, at 16s.	4,769	12	0
	£21,509	12	4

SUMMARY.

	£	s.	d.
Domain Line	14,409	0	4
Tunnel Line	21,394	5	8
Coast Line	21,509	12	4

Notes.

1. No provision is made for pitching the sea embankments in case the excavations at Fort Britomart, &c., do not yield material of sufficient tenacity, and in sufficient quantities for the purpose, so that if pitching becomes necessary, the extra cost would be nearly the same for the Domain and Tunnel Lines, but the increased cost for this purpose would be large for the Coast Line, on account of the greater extent of the sea embankment.
2. There is great uncertainty in the cost of the tunnel, and considerable risk in its execution.
3. The tunnel would make the station for Parnell costly and inconvenient.

HENRY WRIGG,
15th August, 1871. Engineer-in-Charge.

No. 3.

WAIKATO RAILWAY.—Memorandum by Mr. BLACKETT.

THE annexed report (15th August, 1871), accompanied by two tracings, is forwarded by Mr. Wrigg for the purpose of enabling the Government to decide as to which of the three lines between Newmarket and the wharf at Auckland shall be adopted. The lengths and estimates are as follows, viz.:—

	£	s.	d.
Domain Line, 2 miles 3 furlongs 1 chain	14,409	0	4
Tunnel Line, 2 miles 1 furlong	21,394	5	8
Coast Line, 3 miles 3 furlongs 1 chain	21,509	12	4

The feeling being decidedly against the Domain Line, on account of it passing through a favourite place for recreation from end to end, the choice may lie between the Tunnel Line and Coast Line.

It will be seen that their estimated costs are nearly equal, and that Mr. Wrigg notes the risk of undertaking the Tunnel Line (on which I have already strongly reported), and the consequent uncertainty of its cost. The objections to the Coast Line are, its extra length (one mile on a dead level), and the doubt that exists of the material of which the cliffs are composed, and which will be used in forming the embankment, being able to stand the wash of the sea or harbour.

I think this need not be dreaded, as a good wide flat slope can at first be given to the embankment, which afterwards may be protected with hard scoria rock brought down from Newmarket at a small expense after the line is opened and applied to those parts needing protection; it may be placed at random and not *pitched*, and will thus resist the action of the surf better, and cost very much less.

22nd August, 1871. J. BLACKETT, C.E.

Mr. Blackett,—Can you tell me whether the coast line would reclaim tidal land in Mechanics Bay, and, if so, what extent?—W. Gisborne, 24th August, 1871.

Mr. Gisborne,—The plan shows that about 10 acres would be reclaimed in Mechanics Bay; but I should not think that the full cost of reclamation is included in estimate. The bay, however, is very shallow, and would not require much filling.—J. Blackett, C.E., 24th August, 1871.

For His Honor Mr. Gillies,—Would you favour me with your opinion on these alternative lines? My own opinion inclines to the Coast Line.—W. Gisborne, 24th August, 1871.

Looking to the relative cost of the Tunnel and Coast Lines, and their relative risks and advantages, I have no hesitation in giving my opinion in favour of the Coast Line.—T. B. Gillies, 25th August, 1871.